The Impact Of Image-Size Manipulation And Sugar Content On Children's Cereal Consumption

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ABSTRACT

Previous studies have demonstrated that portion sizes and food energy-density influence children's eating behavior. However, the potential effects of front-of-pack image-sizes of serving suggestions and sugar content have not been tested. Using a mixed experimental design among young children, this study examines the effects of image-size manipulation and sugar content on cereal and milk consumption. Children poured and consumed significantly more cereal and drank significantly more milk when exposed to a larger sized image of serving suggestion as compared to a smaller image-size. Sugar content showed no main effects. Nevertheless, cereal consumption only differed significantly between small and large image-sizes when sugar content was low. An advantage of this study was the mundane setting in which the data were collected: a school's dining room instead of an artificial lab. Future studies should include a control condition, with children eating by themselves to reflect an even more natural context.

Keywords: children, advertising, image-size manipulation, cereal intake, consumption, front-of-pack marketing

Introduction

Young children often eat cereals for breakfast. Most of the child-targeted cereals exceed the daily recommended amount of sugar and kids tend to consume more than the suggested amount of 30g (Guthrie & Morton, 2000; IOM, 2006, Batada, Seitz, Wootan & Story, 2007; Schwartz, Vartanian, Wharton & Brownell, 2011; LoDolce, Harris & Schwartz, 2013).The marketing of unhealthy food is known to be an important factor that contributes to childhood obesity (IOM, 2006; FTC, 2012; WHO, 2012; EU Pledge, 2012; Persson, Soroko, Musicus & Lobstein, 2012). Although many studies proved that persuasive techniques , such as endorsement, affect children's food attitudes and preferences (Smits, Vandebosch, Neyens, & Boyland, 2014), little attention was paid to the impact of more subtle marketing techniques such as the image-size of food serving suggestions on children's actual eating behavior.

Several experiments have already demonstrated that larger portion sizes and food energy-density (calories/gram) increase food consumption in children (e.g. Rolls, Engell & Birch, 2000; Fisher, Rolls & Birch, 2003; Fisher, 2007; Fisher, Liu, Birch & Rolls, 2007b; Leahy, Birch & Rolls, 2008a,b; Leahy, Fisher, Birch & Rolls, 2008; Spill, Birch, Roe & Rolls, 2010; Looney & Raynor, 2011; Marchiori, Corneille & Klein, 2012). Fisher, Liu, Birch, and Rolls (2007), for instance, offered 5 to 6 year old children a macaroni and cheese meal, and manipulated served portion-size and energy-density in a repeated measures design. They discovered that children consumed significantly more grams when served a larger portion-size, and significantly more calories when energy-density was high. More recently, Looney and Raynor (2011) examined the effects of served snack portion-size and energy-density on preschool children's food intake (grams and calories). In contrast to Fisher's et al.'s study, their experiment only identified a main effect of portion-size on snack energy consumption (calories). However, prior studies focused on actual portion size and energy-density, while the potential impact of marketing prone image-size manipulations and sugar content is still understudied. To date, only one recent article addressed the influence of on-pack serving size recommendations on adult's expected consumption of unhealthy food (Versluis, Papies, Marchiori, 2015). In this study, pictorial portion instructions reduced adult's expected food intake (Versluis, Papies, Marchiori, 2015). Many child targeting foods feature such pictorial suggestions on portion size, such as cereal boxes that often display a big bowl filled to the rim with cereals and milk. Nevertheless, intervention studies manipulating such marketed presentation of consumer goods are underrepresented in the literature despite the policy-induced scalability of such interventions should they prove to be successful. To address this gap, the present study examines whether suggestive image-size manipulations on cereal packaging and actual sugar content influence the consumption of cereals among preschool children.

Visual cues such as the image-size of front-of-pack food depictions, are expected to influence children's eating behavior, because children perceive portion-size by food height and diameter (see Fisher & Krall, 2008; Piaget, Inhelder & Szeminska, 1960). We hypothesized (Hypothesis 1) that children would pour more cereal into their bowl, consume more cereal and drink more milk with their cereal when exposed to a larger image-size manipulation compared to a smaller image-size manipulation.

Furthermore, despite the inconsistent findings concerning the consumption effect of energy-density (Fisher & Krall, 2008), we can expect children to prefer sugary cereals over less sweet cereals because children have an innate soft spot for sweets (Cowart, 1981). We thus expected children to eat more cereal in the higher sugar content conditions (Hypothesis 2). In addition we aimed to explore possible interaction effects between image-size and sugar content. Finally, we controlled for the effects of BMI, overall liking of cereal and feelings of hunger.

Methods

Participants and procedure

Twenty-two Flemish parents of children between four and five years old from a Belgian elementary school gave informed consent to let their child participate in the experiment (M_{age} = 4.36, *SD* = 0.49, 10 boys and 12 girls). Parents of all 26 children of the same class got a letter asking for informed consent. This letter conveyed information about the study. None of the parents indicated their child was allergic or didn't like cereals. However, parents of four out of the 26 children didn't give informed consent and therefore their kids did not participate in the experiment. The institutional review board of the Leuven university (Social and Societal Ethics Committee) approved the protocol of this study. A 2 x 2 x 2 mixed experimental design, similar to Looney and Raynor's (2011) design, was used: image-size manipulation (small vs. large) x sugar content (low vs. high) x presentation-order. Image-size and sugar content were manipulated within-subjects, presentation-order was manipulated between-subjects to counterbalance spurious effects due to presentation order: the group of 22 children was divided in two and experienced the four within-subjects conditions in different orders. Children were randomly assigned to one of the two order conditions.

Two different cereal packages were designed (Adobe Photoshop CS5) differing only in image-size manipulations (see Figure 1, Appendix). The cereal box measured 19x29 cm and the design was based on an Italian brand unknown to the participating children: Mr. Kanny™. Furthermore, two types of cereal, also unknown to the participating children, were used. These differed in sugar content: Crownfield's Frosted Flakes™ (9 g sugar/ 30 g), and Crownfield's regular Corn Flakes™ (1g sugar/ 30 g). The four sessions took place on Wednesday mornings at the school's lunch room where a buffet of cereal breakfast was served, with the experimental cereal box clearly visible at the center. Parents were instructed not to feed their child breakfast the days of the experiment. At the start of the first session, children were measured and weighed.

The children were told a new brand wanted to sell cornflakes on the Belgian market and wanted to find out whether children would like it or not. The children were led to believe they were test-subjects who had to taste the new brand. For every child coded (stickers) bowls, spoons and jugs of milk (250 ml) were presented at the table. The children were called one by one to the breakfast buffet. Each child got the same instruction*: "I have some cornflakes, take a good look at the box first and then take as much as you want to eat. You may also refill later".* The children then ate together with their classmates.

This process was filmed to control for unexpected circumstances such as children eating from each other's bowls (only the bowls and cups were visible). The sessions took about thirty minutes to complete.

Measures

The first dependent variable was the amount of poured cereal. The box of cereal was weighed before the experiment. Each time a child poured cereal, the box was weighed again and the remaining weight was listed separately for each child. The second dependent variable, eating behavior, was measured at the end of the experiment: all bowls were weighed separately. The remaining quantity in the bowl was deducted from the total amount they poured in their bowl. Thirdly, the poured and consumed quantity of milk was measured. All children had their own jug of milk (250 ml) so the remaining amount of milk in both the jug and the bowl could be measured after the experimental sessions.

Covariates were BMI, overall liking of cereals, and feelings of hunger. BMI was measured by dividing the children's body weight by the square of their height (Quetelet, 1835). BMI criteria differ between children and adults, with childhood criteria based on percentiles rather than absolute scores. From the 85th percentile children are considered overweight (Barlow, 2007). Overall liking of cereals in general was measured during the first session only, before exposure, on a three-point cartoon Likert-scale (Looney & Raynor, 2011; Fisher et al., 2007b; Birch, 1979). Children were asked to indicate which smiley expressed how tasty they found cereals, ranging from 'not tasty' to 'very tasty'(1-3). Hunger was measured before each session with a series of three cartoon drawings developed by Birch (Birch & Fisher, 2000), ranging from 'not hungry' to 'very hungry'(1-3).

Analyses

To test the effects of image-size manipulation on the amount of cereals children poured into their bowl, and the amount of cereal and milk consumption, we performed three different mixed Anova analyses (without covariates).

Results

The children had a mean BMI of 15.83 (SD = 1.06). About 18% of the children were overweight (N = 4, BMI 85th percentile). Children indicated they liked cereal (M_{u0} = 2, M = 2.45, SD = 0.67; $t(21)$ = 3.18, p = .005). The average value of hunger across all sessions was 2.28 (SD = 0.50, $t(21)$ = 12.00, p < .0001), which implies the children were rather hungry. A repeated measures analyses with image-size manipulation and sugar-value as within-subjects factors, and order as a between-subjects variable verified that hunger did not vary significantly between the conditions ($F(1,20)$ = 0.94, p = .344).

Effects of Image-Size on Children's Cereal and Milk Consumption.

A significant main effect of image-size manipulation appeared on the amount of poured cereal ($F(1, 21)$ = 17.87, p < .0001, η_p^2 = .46, r = .98). Children poured significantly more cereal in their bowl when exposed to a larger image-size, confirming H1. The main effect of image-size on cereal intake was also significant, ($F(1,21)$ = 22.3, p < .0001, η_p^2 = .52, r = .99), with a higher mean consumption when a larger image-size was shown compared to a smaller one. Concerning milk consumption, the main effect of image-size also reached significance ($F(1,21)$ = 27.51, p < .0001, η_p^2 = .57, r = .99). Children drank significantly more milk with their cereal when image-size was large instead of small. This means that confirmation for the first hypothesis has been found, children consume more when image-size is large instead of small. Table 1 illustrates the effectiveness of image-size on young children's cereal and milk consumption.

Table 1: The amounts poured and consumed after exposure to the different image-size conditions

	t	*p*	*d(av)*	*M*small	*SD*small	*M*large	*SD*large
Poured cereals	-3.81	0.001	-0.81	14.80	4.42	18.39	4.05
Consumed cereals	-4.12	0.0001	-0.88	15.93	5.31	20.59	4.99
Consumed milk	-6.58	0.0001	-1.4	199.18	12.23	216.34	13.93

Effects of Sugar Content on Children's Cereal and Milk Consumption.

Sugar content had no main effects on cereal ($F(1,21) = .019$, $p = .891$, $\eta_p^2 = .001$, $r = .05$) and milk consumption ($F(1,21) = .38$, $p = .542$, $\eta_p^2 = .02$, $r = .09$). H2 was not confirmed.

Interaction effects between image-size and sugar content.

No interaction-effect was found between image-size and sugar content to predict the amount of poured cereal ($F(1,21) = 1.55$, $p = .227$, $\eta_p^2 = .07$, $r = .22$). For cereal consumption, on the other hand, the interaction was significant ($F(1,21) = 5.56$, p = .028, $\eta_p^2 = .21$, $r = .61$). Cereal consumption only differed significantly between small and large image-sizes when sugar content was low ($M = 14.68$, $SD = 6.62$; $M = 21.68$, $SD = 6.59$, $t(21) = -4.81$, $p < .0001$, see Figure 2). In the high sugar content conditions cereal consumption did not differ significantly between small and large image-size groups ($M = 17.18$, $SD = 5.32$; $M = 19.5$, $SD = 6.4$, $t(21)= -1.73$, $p = .099$), although the direction of the effect is similar. Confirming our expectation, the interaction between image-size and sugar content was significant. We also found a significant interaction between image-size and sugar content to predict milk consumption ($F(1,21) = 4.32$, $p = .050$, $\eta_p^2 = .17$, $r = .51$). However, the differences between small and large image-size conditions were significant for both sugar-level conditions (LSV: $M_{small}= 195.64$, $SD = 13.24$; $M_{large}= 217.77$, $SD = 17.94$, $t(21)= -5.28$, $p < .0001$; HSV: $M_{small}= 202.73$, $SD = 17.99$; $M_{large}= 214.91$, $SD = 15.77$, $t(21)= -3.12$, $p = .005$, see Figure 3).

Body Mass Index and Perceived Tastiness of Cereal.

The same mixed Anova analysis was carried out with the addition of the covariates BMI z-score and overall liking of cereals to test whether these variables influence the impact of image-size and sugar content on the dependent variables. For the amount of poured cereal, the main effect of image-size was not significant anymore ($F(1,19) = 0$, $p = .994$, . $\eta_p^2 = 0$, $r = .05$). Image-size manipulation did not interact with BMI z-score ($F(1,19) = 1.45$, $p = .244$, η_p^2

= .07, *r* = .21), nor liking of cereal (F(1,19) = 1.35, *p* = .261, η_p^2 = .07, *r* = .2). Overall liking of cereal had a significant positive between-participants effect (F(1,19) = 7.07, *p* = .015, η_p^2 = .27, *r* = .71). Concerning cereal consumption, the image-size effect lost significance after including BMI z-score and overall liking of cereal as covariates (F(1,19) = .09, *p* = .773, η_p^2 = .004, *r* = .06). Interactions between image-size and BMI z-score (F(1,19) = 1.43, *p* = .246, η_p^2 = .07, *r* = .21) and between image-size and overall liking of cereal, were not significant (F(1,19) = 2.66, *p* = .119, η_p^2 = .12, *r* = .34). Only the three-way interaction between image-size, sugar content and BMI z-score was significant (F(1,19) = 5.72, *p* = .027, η_p^2 = .23, *r* = .62). The three-way interaction indicates this effect differs according to BMI. A spotlight analysis revealed that the interaction between image-size manipulation and sugar content only holds for a BMI at the mean and one standard deviation above the mean (*M* = 15.83, > *M* = 16.89). Children with an average and above average BMI only ate more cereal when image-size was large instead of small, when sugar content was low. Overall liking of cereal had a significant positive between-participants effect (F(1,19) = 4.38, *p* = .050, η_p^2 = .19, *r* = .51). Finally, regarding milk consumption, the main effect of image-size manipulation was not significant anymore after controlling for BMI z-score and overall liking of cereal (F(1,19) = .11, *p* = .748, η_p^2 = .01, *r* = .06). No interaction between image-size on the one hand, and BMI z-score (F(1,19) = .92, *p* = .349, η_p^2 = .05, *r* = .15), and overall liking of cereal on the other hand, emerged (F(1,19) = 1.13, *p* = .300, η_p^2 = .06, *r* = .17). When ignoring all other variables, overall liking of cereals had a significant between-participants effect on milk consumption (F(1,19) = 20.91, $p < .0001$, η_p^2 = .52, *r* = .99). BMI z-score had no significant between-participants effects on neither dependent variable.

Discussion

Confirming our first hypothesis, we found evidence for the fact that there were main effects for image-size manipulation on all dependent variables. When children were exposed to a large image-size they poured more cereal into their bowl, ate more cereal and drank more milk with their cereal than when exposed to a smaller image-size. The current findings suggest that providing a clear and noticeable reference amount for the consumption decision in the form of a image-size recommendation signals to the consumer how much is appropriate to eat (Versluis et al., 2015). Similar to Looney and Raynor's experiment (2011) we found no main effects for sugar content, thus refuting our second hypothesis. In contrast to previous studies, we found important interaction effects for sugar content (e.g. Fischer, Liu, Birch & Rolls, 2007; Looney & Raynor, 2011). The effect of image-size on cereal consumption only occurred when sugar content was low. It is interesting that sugar appeared to have a moderating effect on the relationship between image size and the amount of cereal eaten, while sugar content did not affect cereal intake in univariate analyses.

Cereal and milk consumption were predicted by two-way interactions between image-size manipulation on the one hand, and sugar content on the other hand. However, no main effects for image-size manipulation were found when covariates were included. This means that the hypotheses cannot be confirmed with the mixed Ancova. As in previous experiments, we found no main nor first-order interaction effects for BMI z-score. However, the three-way interaction between image-size, sugar content and BMI z-score predicted the amount of cereal consumption. We also found interaction effects between image-size, sugar content and presentation-order when the latter was included as a between-participants factor. However, an explanation of the influence of presentation-order remains unclear. An interesting finding emerged in both analyses: children ate the most cereal when image-size manipulation was large and sugar content was low. Although the effect of image size was stronger (and significant) for cereals low in sugar content than for cereals high in sugar content, the pattern of findings was comparable. Now, would serving size suggestions also influence healthy food options, as was the case for our cereals with lower sugar content? Kral Kabay, Roe and Rolls (2010) addressed this question by varying the serving size of fruit and vegetable side dishes in an experiment among 5 to 6 year olds. They observed that doubling the side dish portion sizes only increased children's fruit consumption, while serving size had no effect on their vegetable intake. Even though only one study revealed such effects, it signals that the portion size effect merely occurs with some food types. So, the question needs to be further addressed.

Subtle marketing cues, such as image-sizes, are purposely designed to unconsciously affect young children (Livingstone & Helsper, 2006). We demonstrated that one such design aspect has a clear effect, though it will largely go unnoticed even for adults. Future studies should examine the implicit effects of front-of-pack images on children, in order to develop a better policy. In line with the 'Food Marketing Defense Model' (Harris, Brownell & Bargh, 2009), young children cannot protect themselves against food advertising because they are unaware of marketers' strategies. Prospective experiments should therefore assess from which age children become aware of the aim of suggestive food images. Our findings also suggest that policy makers could reduce unhealthy consumption by regulating package design aspects such as image-size or serving suggestions.

A major limitation was the artificial setting in which the data were collected: the school's dining room, restricting the validity of the findings. Children might react differently in a natural context, for example when they are at home or in the store. In addition, the respondents ate together in the same room, making it possible to be influenced by peers. Future studies should include an additional control condition, with the children eating in isolation, to assess whether kids ate more or less than they usually do. One could also wonder how image-size manipulations influence consumption of other food categories. In addition, this study did not control for personality characteristics influencing children's sensitivity to the effects of image-size manipulation or sugar content. Finally, future studies should also compare the effects of image-size and sugar content between younger and older children.

Conclusion

This study examined whether depicted image-sizes on cereal packaging had an effect on children's consumption. The results showed that four to five year old children ate more cereal when exposed to a pack with a large portion-image compared to a small image. This implies that children are affected by subtle marketing decisions, such as depicted image-sizes. These findings draw attention to the ever-increasing concern for children's health, a phenomenon in which food marketing plays a primary role. So it is both for researchers and for marketers extremely interesting to focus their attention on this hot topic. Given the issue of childhood obesity it may not be appropriate to use larger serving-size depictions on food packaging, regardless of nutritional quality, to prevent over-eating.

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Figure 1: Cornflakes Portion-size images

a small image-size

b large image-size

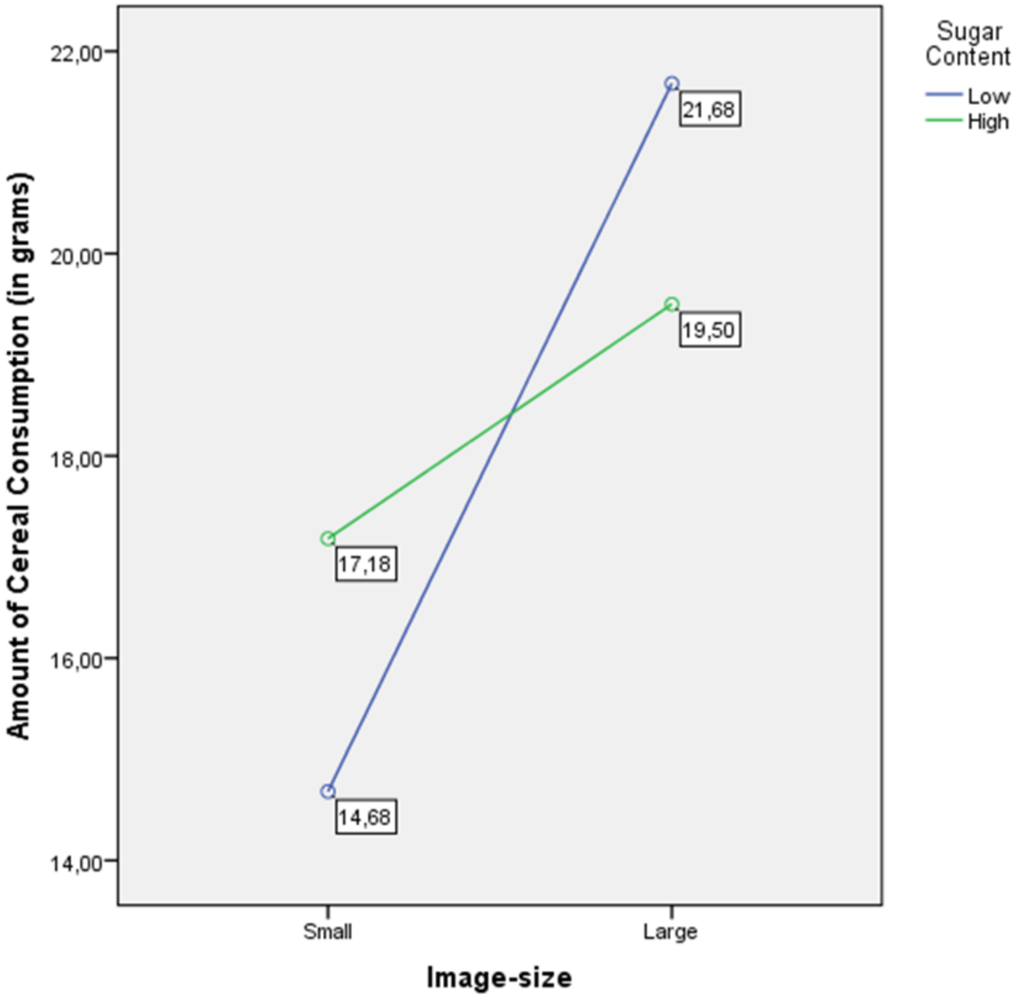

Figure 2. Amount of cereal consumption (in grams) per image-size and sugar content condition

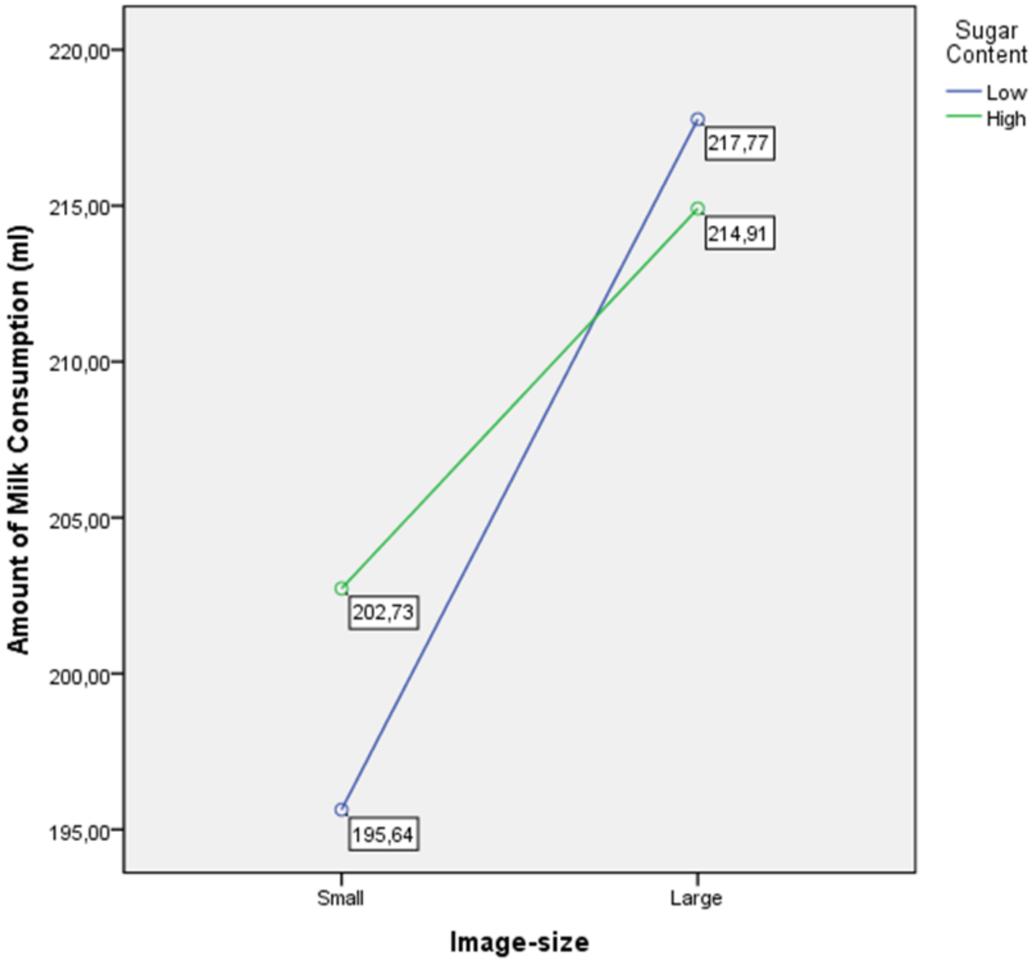

Figure 3. Amount of milk consumption (ml) per image-size and sugar content condition